



# JOINT STRIKE FIGHTER

December 2002



# **VISION**

**BE THE MODEL ACQUISITION PROGRAM FOR  
JOINT SERVICE AND INTERNATIONAL  
COOPERATION**

**DEVELOP AND PRODUCE AN **AFFORDABLE** NEXT  
GENERATION STRIKE FIGHTER WEAPON SYSTEM  
AND SUSTAIN IT WORLDWIDE**



# **“WHAT IS JSF?”**

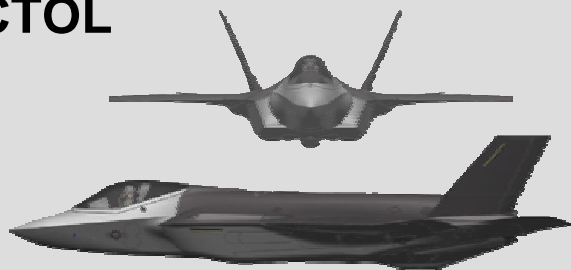


# FAMILY OF **AFFORDABLE** MULTI-MISSION FIGHTER AIRCRAFT USING MATURED/DEMONSTRATED 21<sup>ST</sup> CENTURY TECHNOLOGY



# JSF FAMILY OF AIRCRAFT

## CTOL



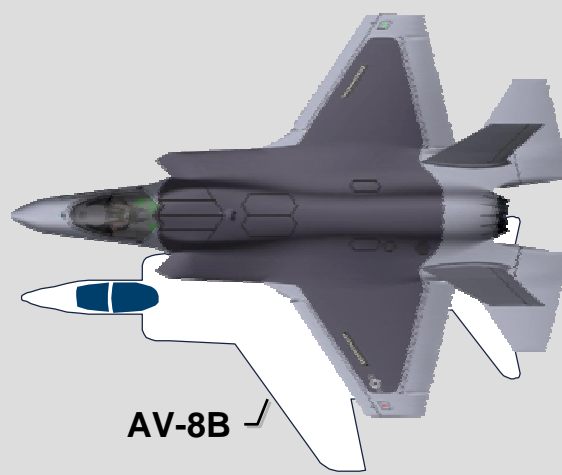
Span (ft)	35
Length (ft)	50.5
Wing Area (ft <sup>2</sup> )	460
Weight Empty (lb)	27,395
Internal Fuel (lb)	18,498



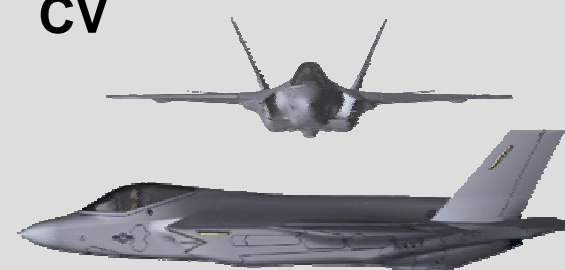
## STOVL



Span (ft)	35
Length (ft)	50.5
Wing Area (ft <sup>2</sup> )	460
Weight Empty (lb)	30,697
Internal Fuel (lb)	13,326



## CV



Span (ft)	43
Length (ft)	50.8
Wing Area (ft <sup>2</sup> )	620
Weight Empty (lb)	30,618
Internal Fuel (lb)	19,624

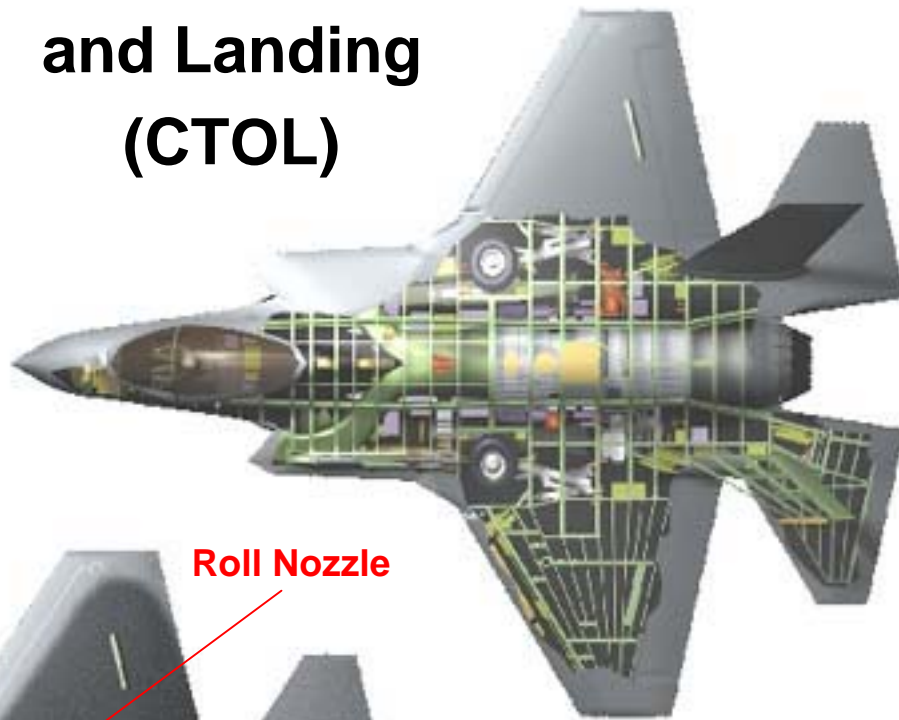
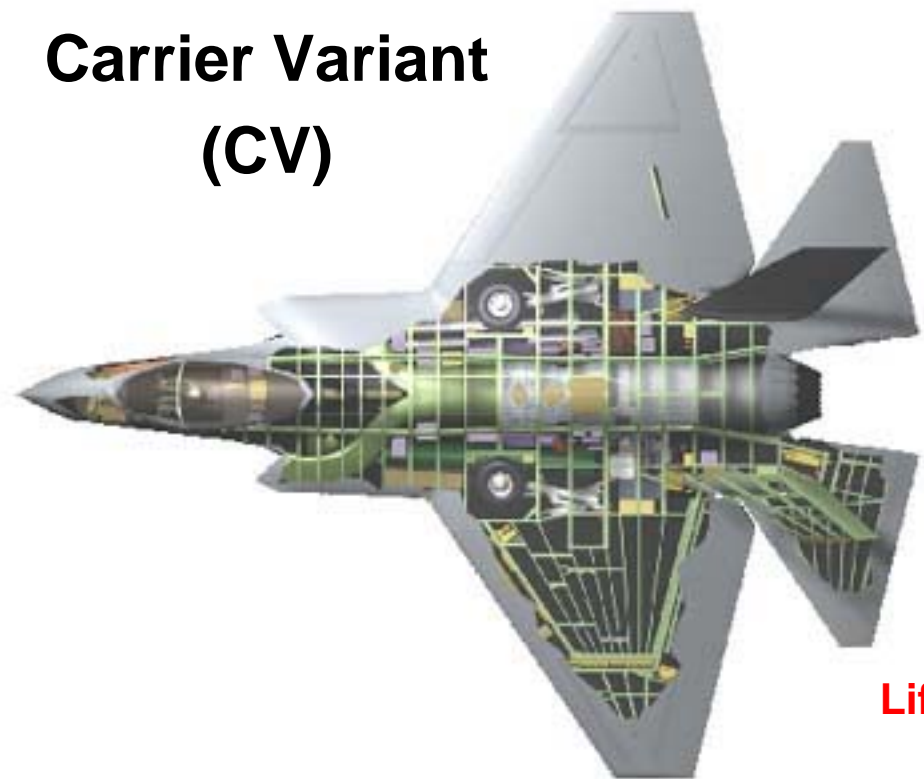




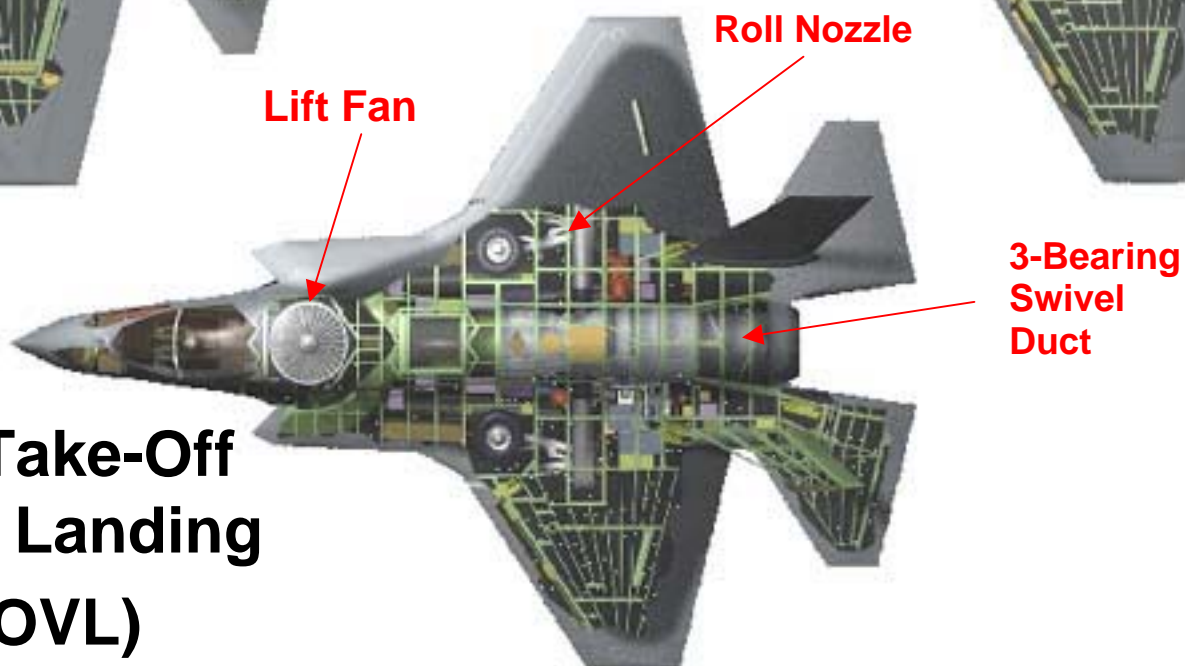
# LOCKHEED MARTIN

**Carrier Variant  
(CV)**

**Conventional Take-Off  
and Landing  
(CTOL)**



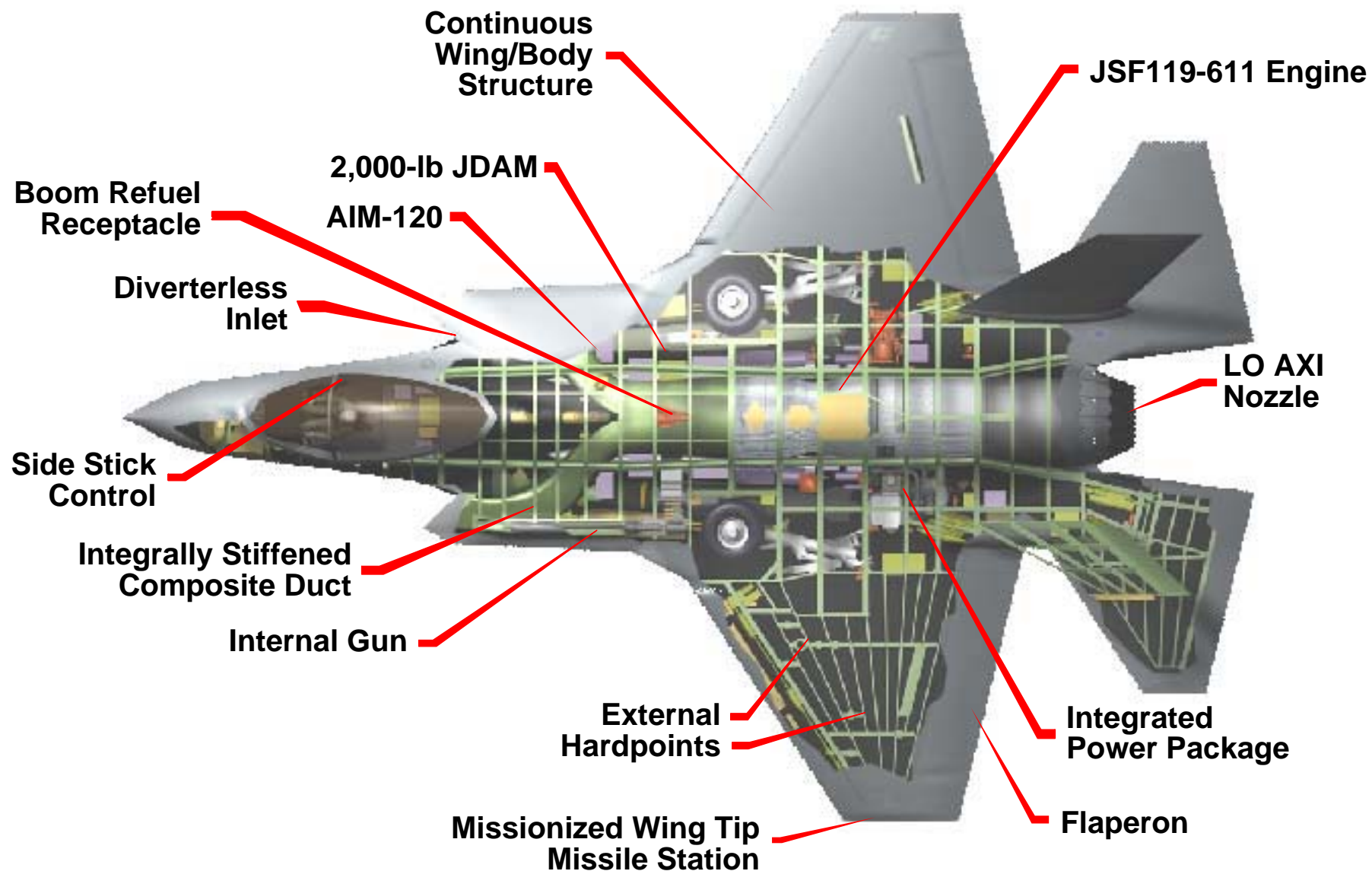
**Short Take-Off  
Vertical Landing  
(STOVL)**





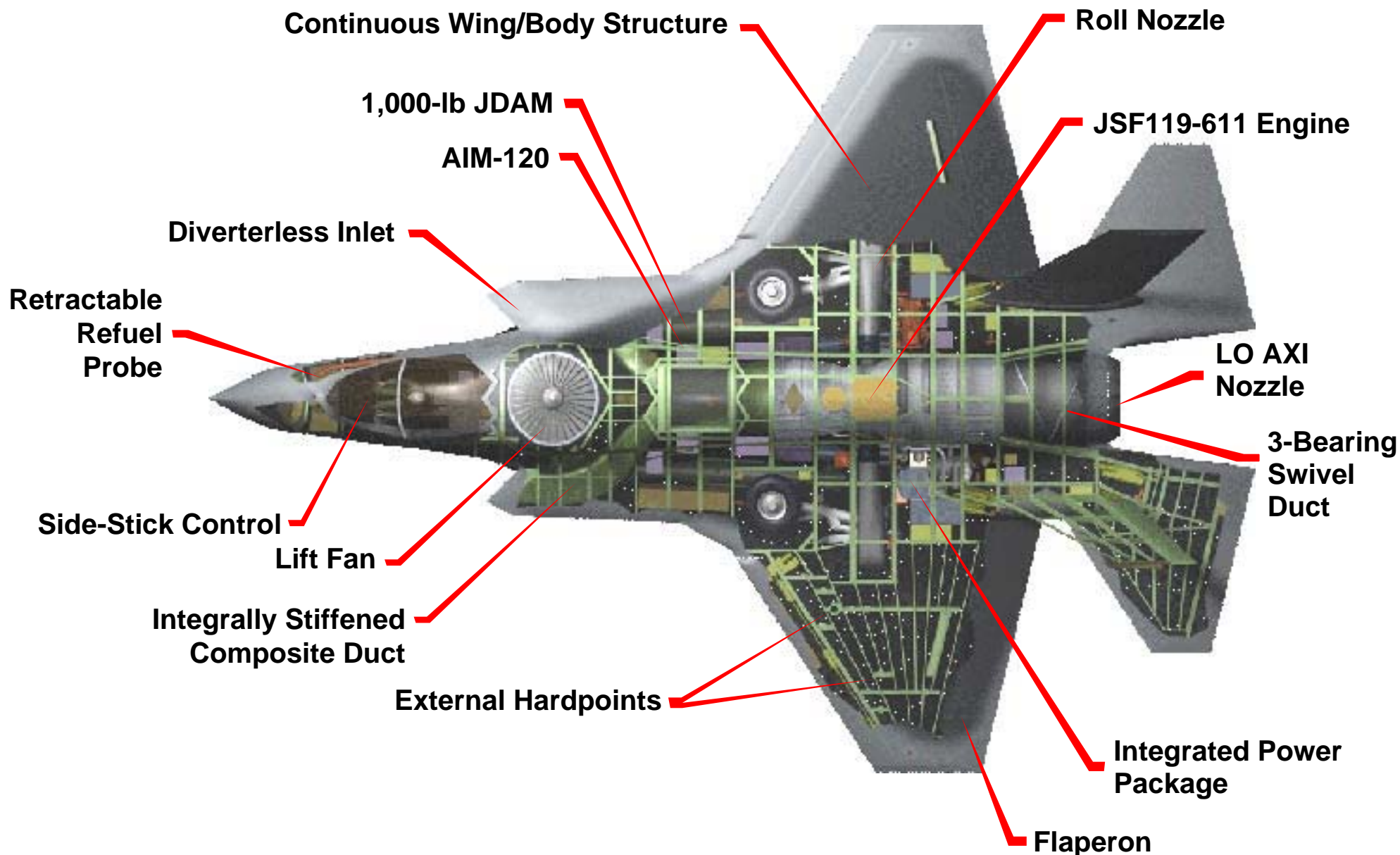


# JSF CTOL CONFIGURATION





# JSF STOVL CONFIGURATION

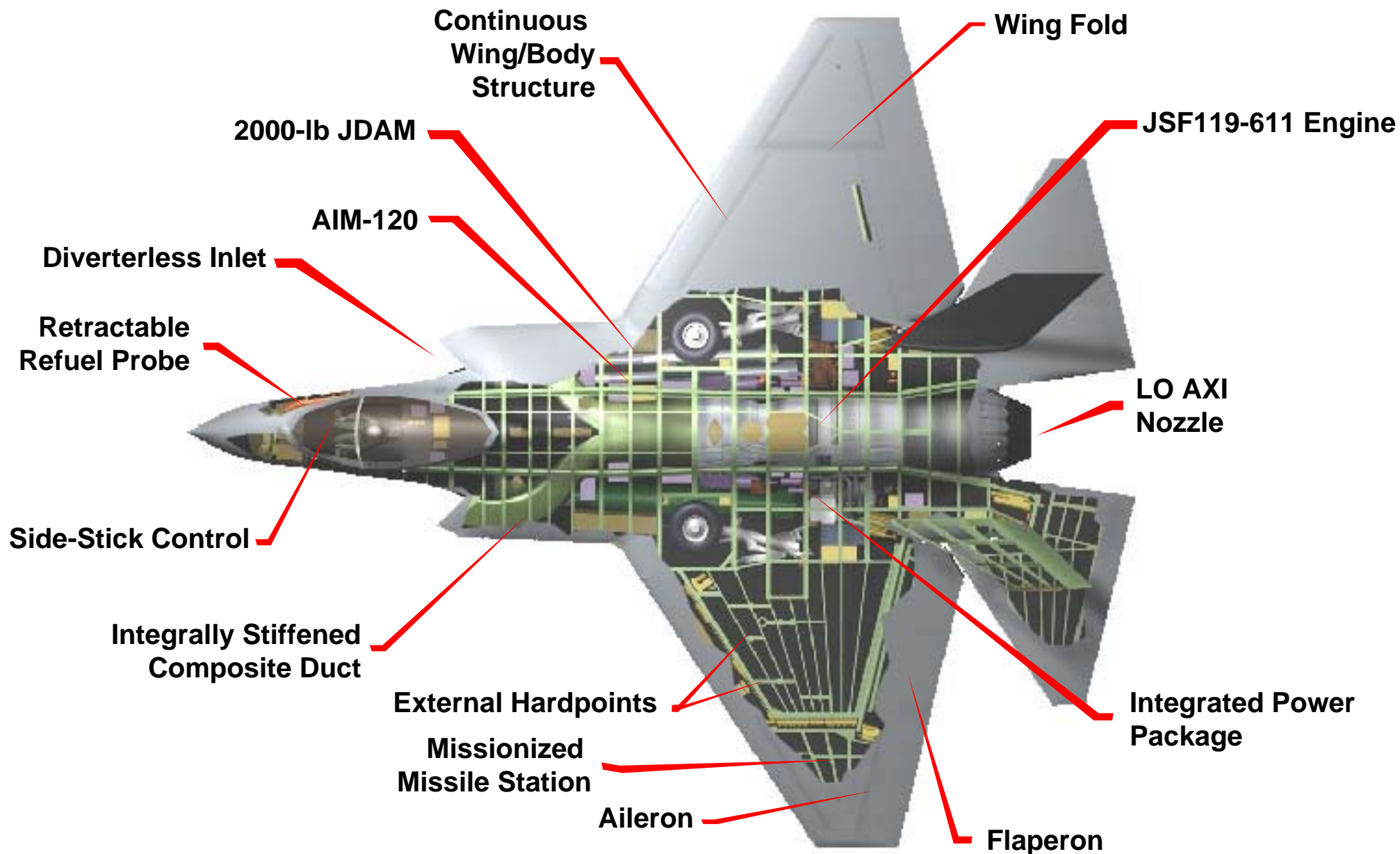


DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.





# JSF CV CONFIGURATION





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# **“WHY DO WE NEED JSF?”**



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# **LEGACY AIRCRAFT**

**OLD & TIRED**

**TOO EXPENSIVE TO MAINTAIN**

**DO NOT MEET WARFIGHTER NEEDS  
POST 2010**



# SERVICE NEEDS

- **USN 480**
  - Multi-role, stealthy strike fighter to complement the F/A-18E/F
- **USAF 1763**
  - Multi-role (primary air-to-ground) fighter to replace the F-16 and A-10 and to complement the F-22
- **USMC 609**
  - Multi-role, short takeoff, vertical landing strike fighter to replace the AV-8B and F/A-18C/D
- **UK (RN and RAF) 150**
  - Supersonic STOVL replacement for the Sea Harrier and GR-7



**3002 US/UK JSFs**



# LOCKHEED MARTIN JSF FAMILY

**CTOL**



**STOVL**



**CV**



<b>Length (ft)</b>	<b>50.5</b>	<b>50.5</b>	<b>50.8</b>
<b>Span (ft)</b>	<b>35</b>	<b>35</b>	<b>43</b>
<b>Wing Area (ft<sup>2</sup>)</b>	<b>460</b>	<b>460</b>	<b>620</b>
<b>Weight Empty* (lb) (Govt Assess)</b>	<b>27,395</b>	<b>30,697</b>	<b>30,618</b>
<b>Internal Fuel (lb)</b>	<b>18,498</b>	<b>13,326</b>	<b>19,624</b>

*\* Includes 6 Percent Uncertainty Margin*





# CTOL JSF PLATFORM COMPARISON

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**F-16C**



**JSF CTOL  
Configuration**



# STOVL JSF PLANFORM COMPARISON

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**AV-8B**



**JSF STOVL  
Configuration**



**F/A-18C**



# CV JSF PLATFORM COMPARISON

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**F/A-18C**



**JSF CV  
Configuration**



**F/A-18E**

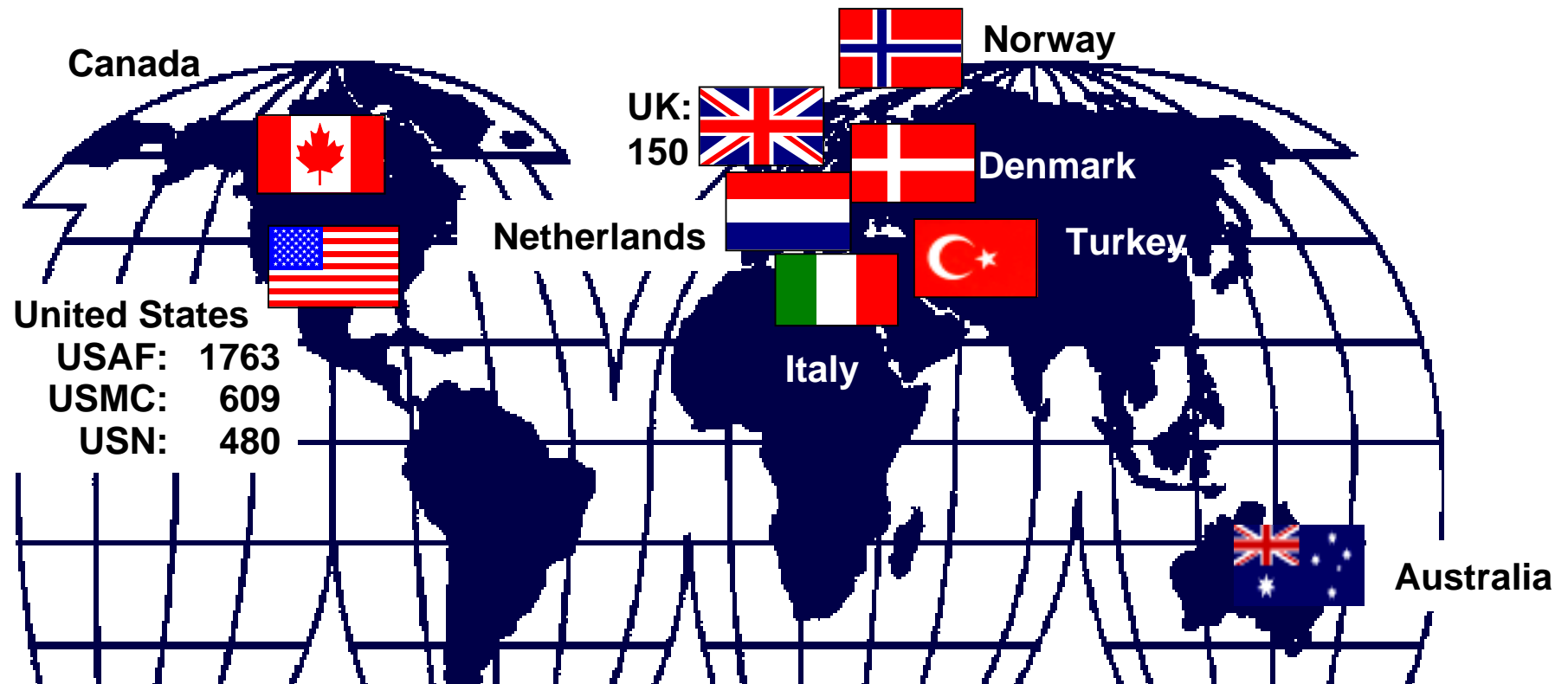


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**“WHO GETS IT?”**



# SERVICE & INTERNATIONAL NEEDS



- **USN:** Multi-role, stealthy strike fighter to complement F/A-18E/F
- **USAF:** Multi-role (primary air-to-ground) fighter to replace F-16 & A-10 & to complement F/A-22
- **USMC:** Multi-role, short takeoff, vertical landing strike fighter to replace AV-8B & F/A-18C/D
- **UK (RN and RAF):** Supersonic replacement for Sea Harrier and GR-7

**3002 US/UK JSFs**  
**> 2000 International JSFs**





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# WHAT IS DIFFERENT ABOUT JSF?



# EVERYTHING!

## PERFORMANCE

## LETHALITY

## SURVIVABILITY

## SUPPORTABILITY

# *Affordability*



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# PERFORMANCE



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**EQUAL OR BETTER THAN**

**F-16**

**F-18**

**AV-8**



# KEY PERFORMANCE PARAMETERS

USMC/UK ★

USN ★

Joint ★

KPP

USMC

USAF

USN

UK

★ Radio Frequency Signature	Very Low Observable			
★ Combat Radius	450 nm USMC Profile	590 nm USAF Profile	600 nm USN Profile	450 nm UK Profile
★ Sortie Generation	4 Surg / 3 Sust	3 Surg / 2 Sust	3 Surg / 2 Sust	3 Surg / 2 Sust
★ Logistics Footprint	< 8 C-17 equivalent loads (20 PAA)	< 8 C-17 equivalent loads (24 PAA)	< 46,000 cu ft 243 ST	< 21,000 cu ft 102 ST
★ Mission Reliability	95%	93%	95%	95%
★ Interoperability	Meet 100% of critical, top-level Information Exchange Requirements Secure Voice and Data			
★ STOVL Mission Performance		N/A	N/A	
Short Take-Off Distance	500'			450' ski-jump
Vertical Lift Bring Back	2 x 1K JDAM, 2 x AIM-120 With Reserve Fuel			2 x 1K JDAM, 2 x AIM-120 With Reserve Fuel
★ Maximum Approach Speed	N/A	N/A	145 knots	N/A

***Projected to Meet or Exceed Requirements***





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# LETHALITY



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**JSF - EXPEDITIONARY!**

**RAPID RESPONSIVENESS**

**FLEXIBILITY/MULTI-MISSION**

**FORWARD PRESENCE /JOINT**

**INTEROPERABLE**



# SURVIVABILITY



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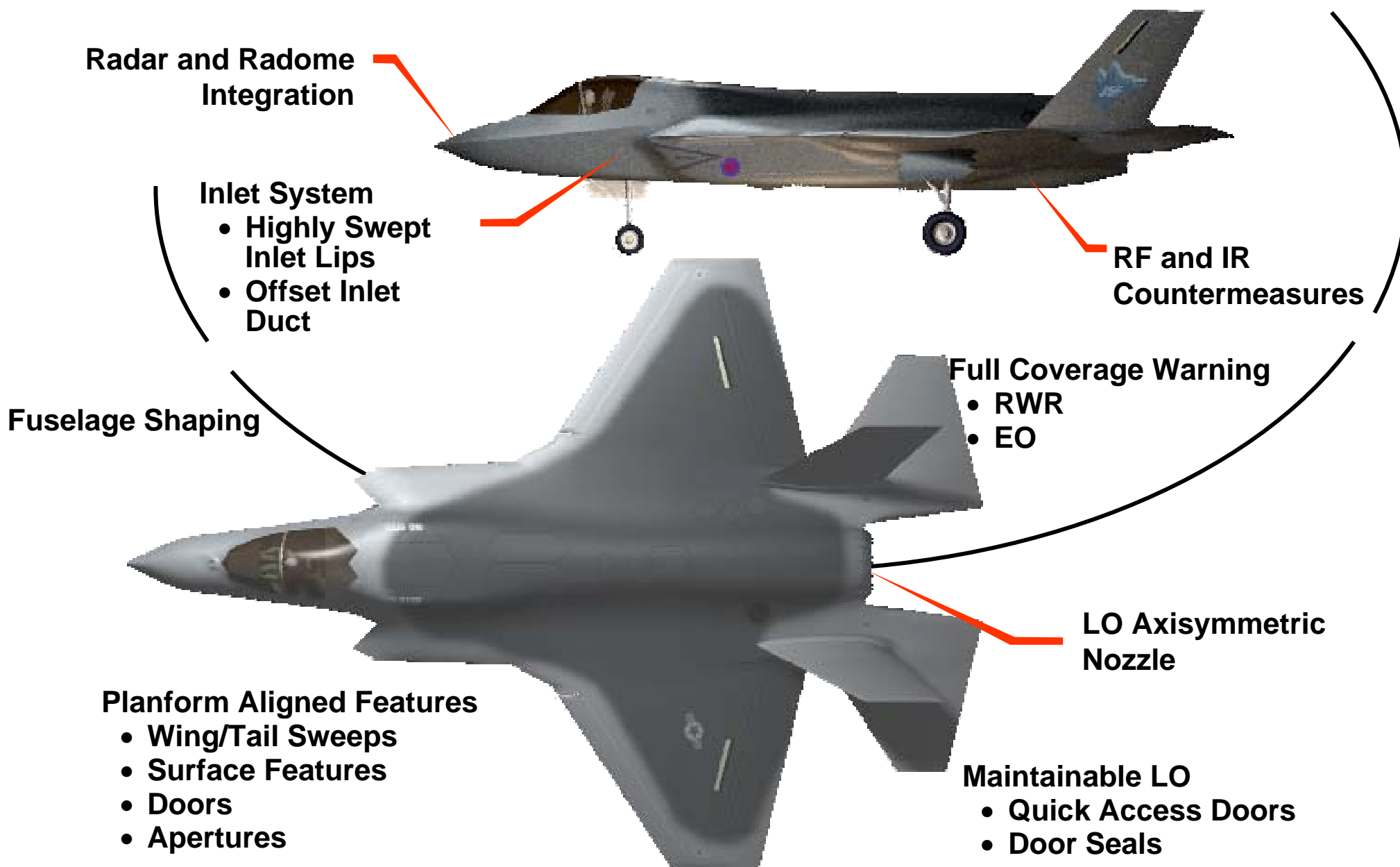
**VEHICLE SIGNATURE  
COUNTERMEASURES  
SITUATIONAL AWARENESS  
AIRCRAFT & WEAPON SYSTEM CHARACTERISTICS**

**ALLOWS JSF TO**

**AVOID, WITHSTAND, AND COUNTER THREATS**



# SIGNATURE/SURVIVABILITY FEATURES





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# SUPPORTABILITY



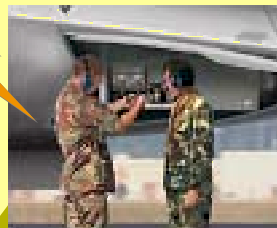
# AUTONOMIC LOGISTICS SYSTEM TECHNICAL SOLUTION

## INTEGRATED SUPPORT

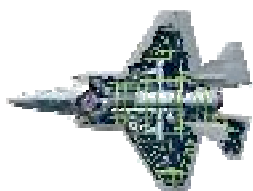
- Design Data → Direct to → Support Information
- Failure Prediction → Remove Unit Before Failure



## TECHNOLOGICALLY-ENABLED MAINTAINER



## AUTONOMIC LOGISTICS INFORMATION SYSTEM



## INTELLIGENT AIR VEHICLE

- Prognostics & Health Management
- Design for Supportability
- High Reliability & Maintainability



## FLIGHT OPERATIONS

- Integration for Optimal Mission Performance
- High Sortie Generation Rate
- Low Logistics Footprint



## Joint Aircrew & Maintainer Training

## INTEGRATED TRAINING

- Common, Joint Pilot/Maintainer Training
- Modular, Flexible Training
- Embedded Training

*Integrated JSF AL System - Affordable,  
Supportable, Survivable, & Lethal*



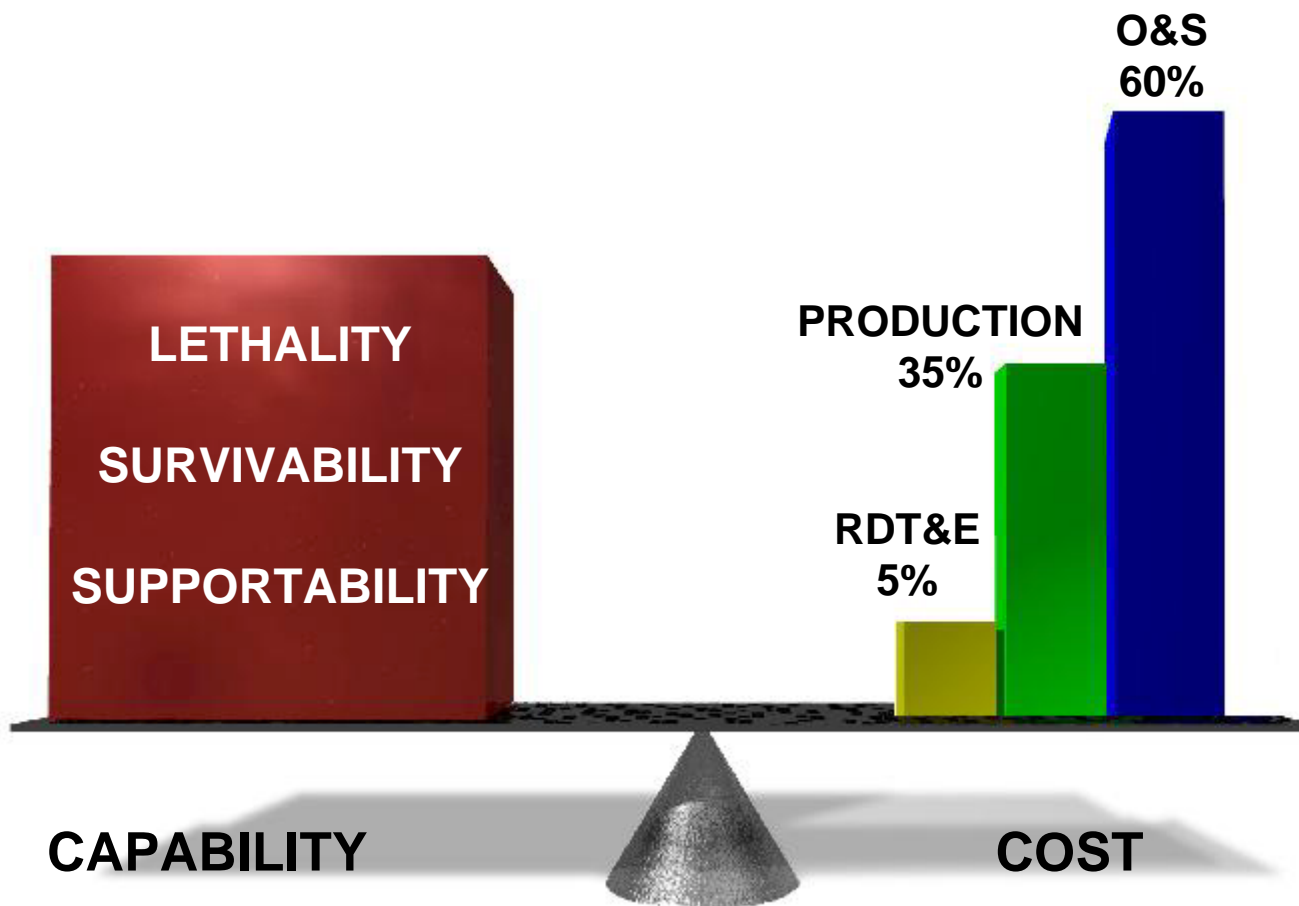


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# AFFORDABILITY



# TACTICAL AIRCRAFT AFFORDABILITY OBJECTIVE

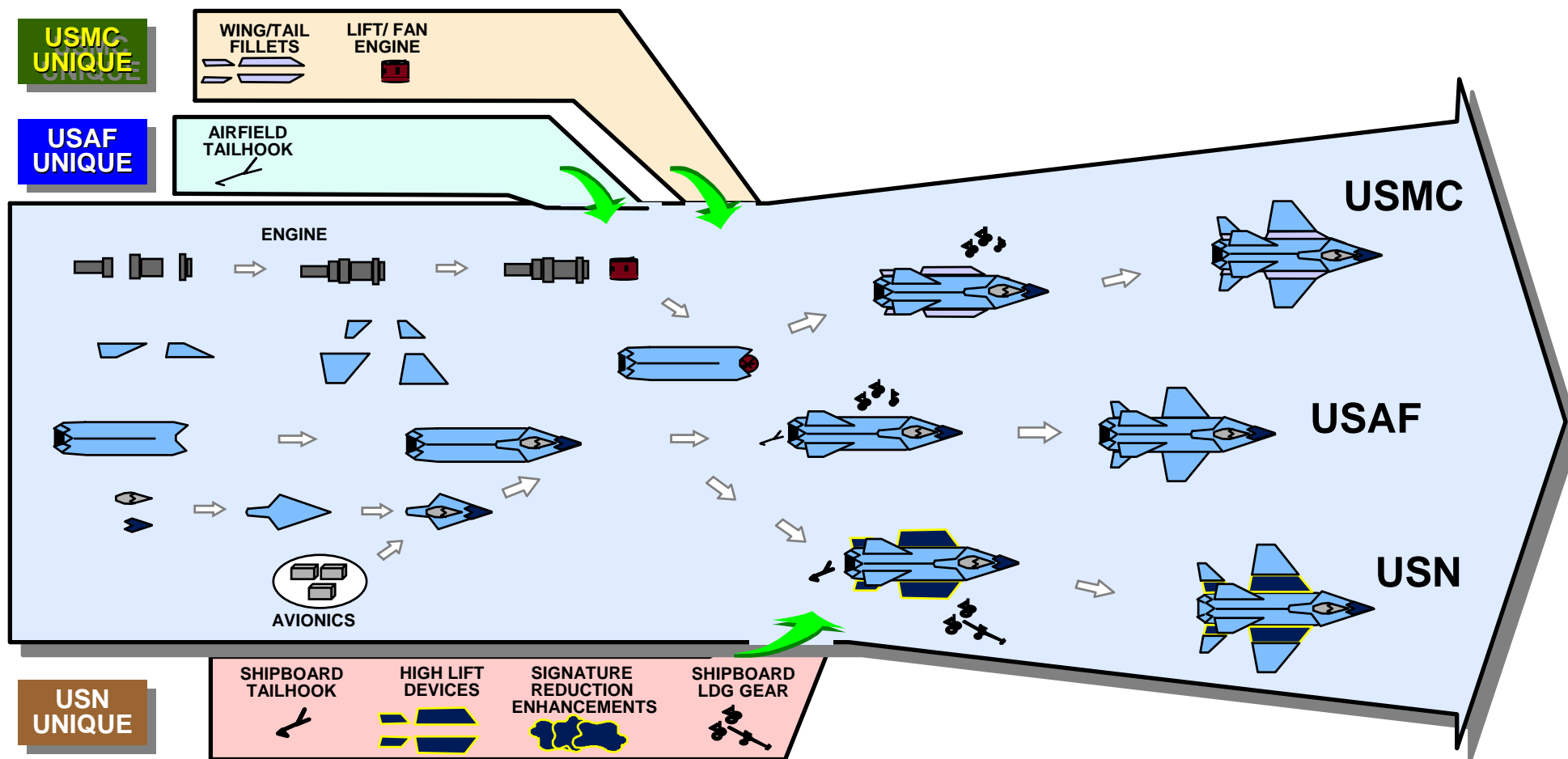


## Affordability

***Cost Objectives Shall Be Set To Balance Mission Needs With Projected Out-Year Resources, Taking Into Account Anticipated Process Improvements In Both DOD And Defense Industries***



# A FAMILY OF THREE AIRCRAFT

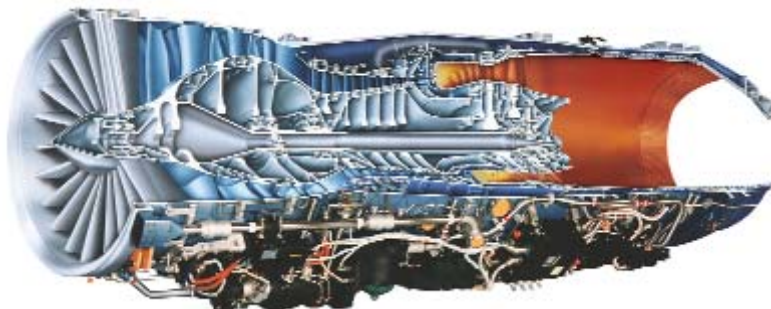


**A Common Production Line To Achieve**  
***Affordability***



# JSF ENGINE INTERCHANGEABILITY

- **Physically** and **Functionally** Interchangeable
- Any Aircraft Able to Use Any Engine
- Common JSF Autonomic Logistics System Interfaces



**PRATT & WHITNEY F135**

**GE AIRCRAFT ENGINES/  
ROLLS ROYCE F136**



***JSF Engines - - Common Core for Aircraft  
Variants, Competition in Production***

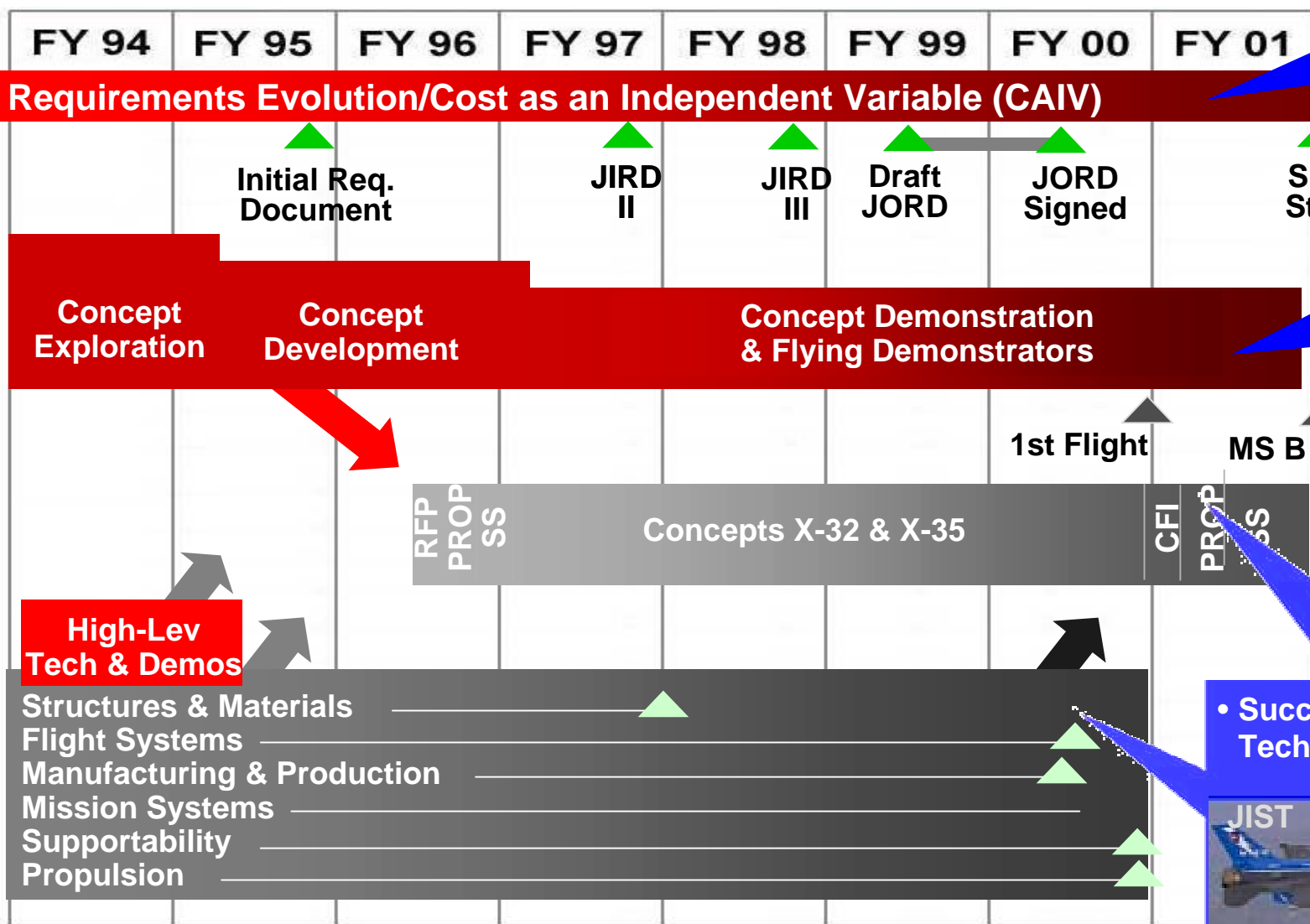


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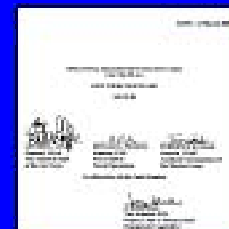
# HOW DID WE GET WHERE WE ARE TODAY?



# CONCEPT DEMONSTRATION PHASE



- Joint ORD Validated by JROC Apr 2000



- CDP Flight Testing Complete



- Boeing and Lockheed Martin PWSC Designs Finalized



- Successfully Leveraged Technologies



Avionics

JIST





# ROADMAP TO THE JORD

**'COST & OPERATIONAL PERFORMANCE TRADES'**

**AOA**



***Feedback & Reiteration Loop Throughout Process***  
***FIVE YEAR EFFORT!!!***






# JOINT OPERATIONAL REQUIREMENTS DOCUMENT


DATE: 13 March 2000

OPERATIONAL REQUIREMENTS DOCUMENT (ORD)  
CAF 302-95-I-A


JOINT STRIKE FIGHTER (JSF)  
ACATID

  
LESTER L. LYLES  
General, USAF  
Vice Chief of Staff  
of the Air Force

  
DONALD L. PILLING  
Admiral, USN  
Vice Chief of  
Naval Operations

  
TERRENCE R. DAKE  
General, USMC  
Assistant Commandant of  
the Marine Corps

In collaboration with the United Kingdom

  
J. S. Blackham  
Vice Admiral (RNL)  
Deputy Chief of Defence Staff  
(Equipment Capability)

- Signed 13 Mar 00
- JROC validated 11 Apr 00
- JROC revalidated 18 Oct 01



# CONCEPT DEMONSTRATION PHASE

## Boeing CDA Detailed Summary

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- **Collected over 700 test points**
- **X-32A/C CTOL/CV Demonstrated:**
  - Flying Qualities (Up & Away)
  - Specific Range & Acceleration
  - External Acoustics
  - Weapons Bay Acoustics
  - Field Carrier Landing Practices
  - Approach Air Speed Handling Qualities and Performance
  - 1.05 Mach @ 30K ft Altitude
- **X-32B STOVL Demonstrated:**
  - In Flight Flow Switches
  - Vertical Landings
  - Short Landings
  - Short Takeoffs
  - Supersonic Accels
  - STOVL External Acoustics
  - 1.05 Mach @ 30K ft Altitude
  - Cross Country Deployment



# CONCEPT DEMONSTRATION PHASE

## Lockheed Martin CDA Detailed Summary

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- **Collected over 700 test points**
- **X-35A CTOL Demonstrated:**
  - Flying Qualities (Up & Away)
  - Specific Range & Acceleration
  - 1.05 Mach @ 25K ft Altitude
- **X-35C CV Demonstrated:**
  - Field Carrier Landing Practices
  - Approach Air Speed Handling Qualities and Performance
  - 1.2 Mach @ 25K ft Altitude
  - 20 Deg AOA
  - Cross Country Deployment
- **X-35B STOVL Demonstrated:**
  - In Flight Lift Fan Engagements
  - Vertical Landings
  - Vertical Takeoffs
  - Short Landings
  - Short Takeoffs
  - Supersonic Flts with STOVL Ops
  - STOVL External Acoustics



# KEY TECHNOLOGY MATURATION PROGRAMS







# TECHMAT SUCCESSES

- **Integrated Flight and Propulsion Controls**
  - CTOL Demo Fall 2000
  - STOVL Demo Summer 2001
- **Propulsion**
  - Advanced Augmenter Tech Program
  - Risk Reduction Improved Hot Section Components
- **JSF Integrated Subsystem Technology**
  - First Flight 24 Sep 2000
- **Supportable Low Observable (LO)**
- **Avionics/Open System Architecture**
  - Test Bed Flights Completed
- **Prognostics & Health Management**
  - Propulsion Seeded Fault Test





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# **WHERE ARE WE TODAY? AND WHERE ARE WE GOING?**



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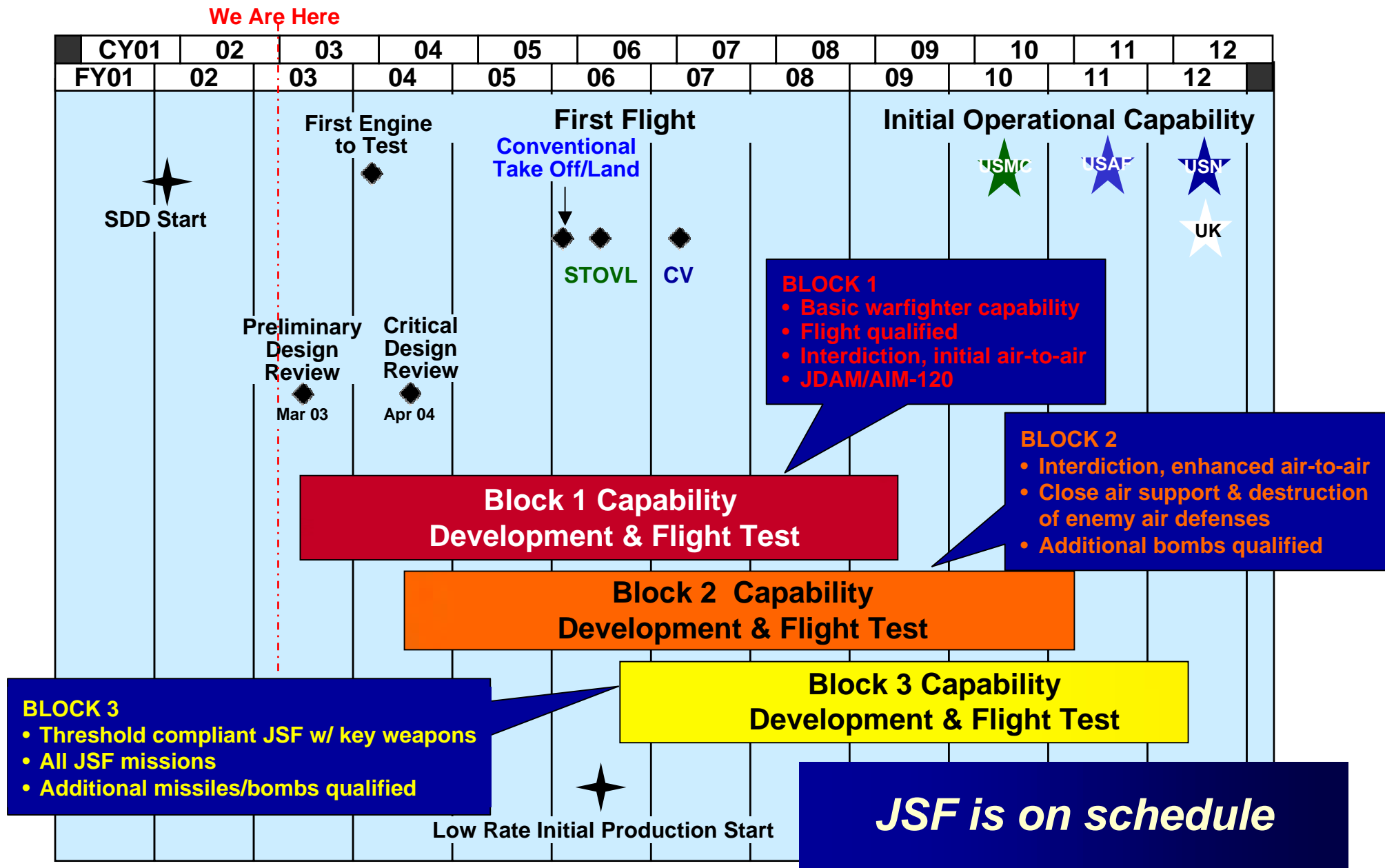
**SYSTEM DESIGN & DEVELOPMENT CONTRACT  
AWARDED TO  
LOCKHEED MARTIN CORPORATION  
AND PRATT & WHITNEY**

**26 OCTOBER 2001**



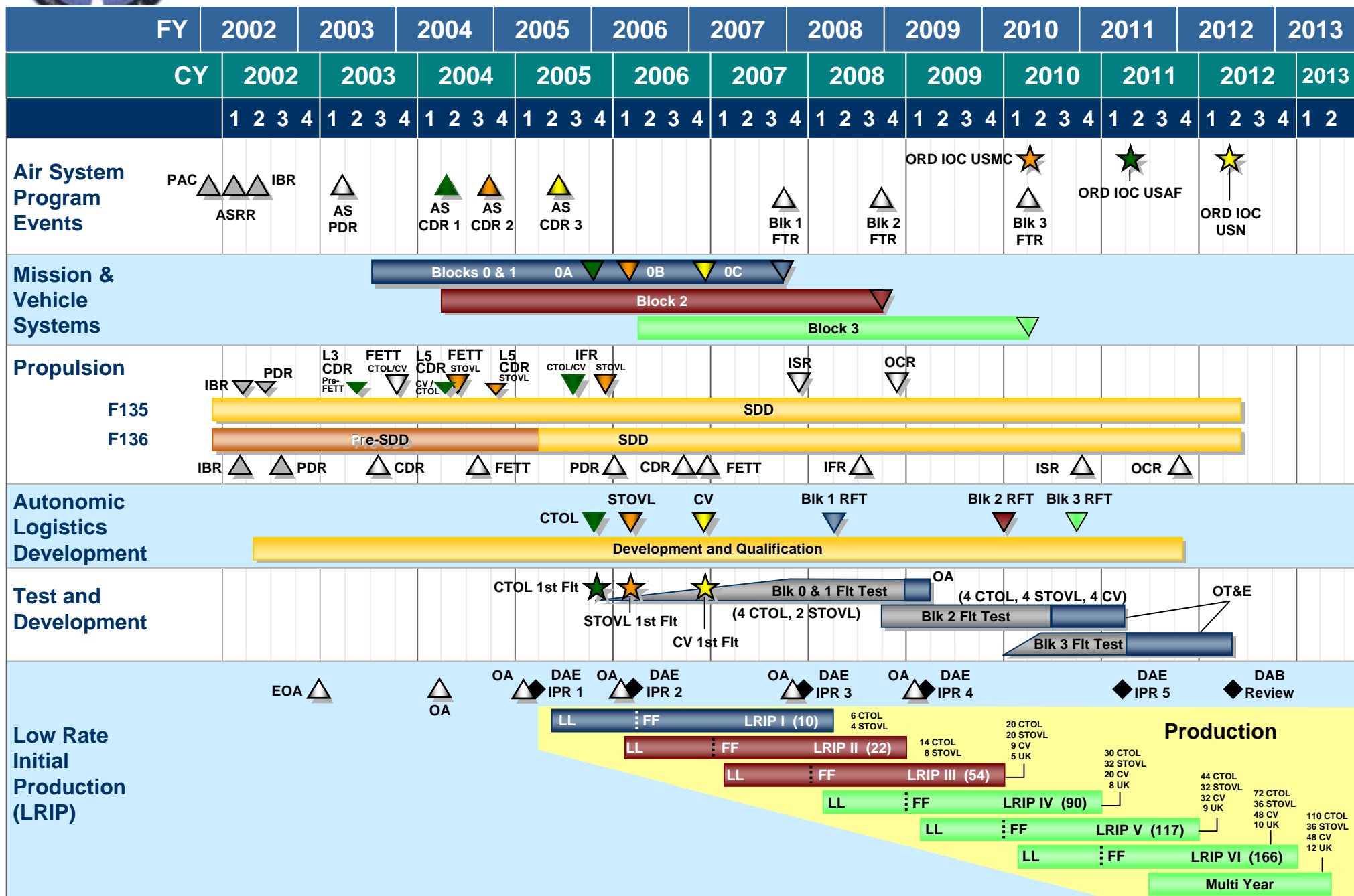


# SYSTEM DEVELOPMENT AND DEMONSTRATION (SDD) SCHEDULE





# JPO TOP LEVEL SCHEDULE





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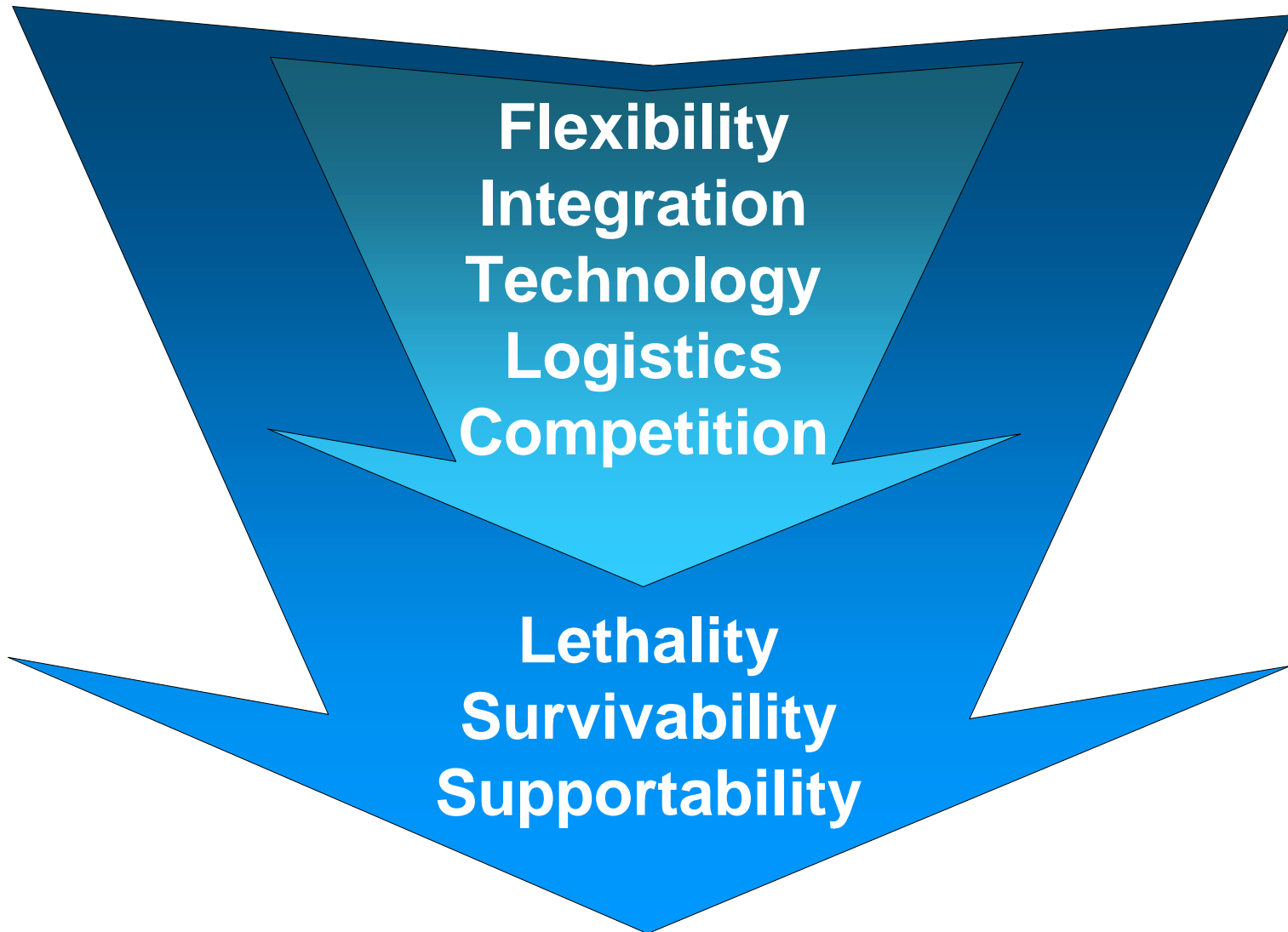
✓ SOURCE SELECTION	FEB - AUG 01
✓ DOWNSelect TO BEST OF BEST	OCT 01
SYSTEM DEVELOPMENT AND DEMONSTRATION PHASE (SDD)	2001 - 2012
MARINES AND AIR FORCE FLYING JSF – IOC 2010/2011	2008
UK AND US NAVY FLYING JSF – IOC 2012	2010



# JSF

## “THE BIG PICTURE”

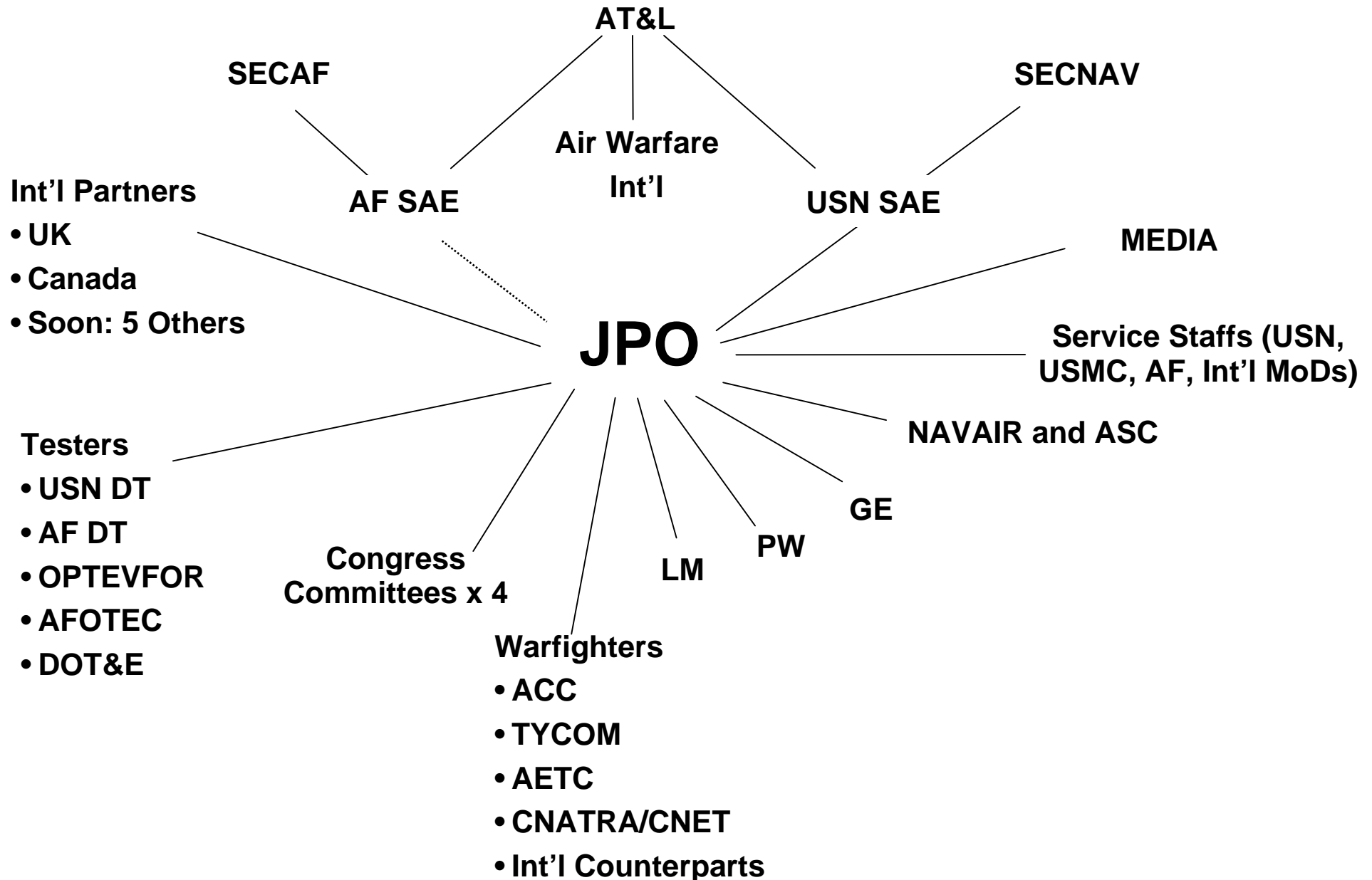
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***Affordable 21st Century Warfighting Capability***



# JSF ENVIRONMENT





# JSF PROGRAM

## • Accomplishments

- ✓ Air System IBRs (LM/NGC/BAE, et.al.)
- ✓ F135 IBR
- ✓ F136 IBR
- ✓ F135 PDR
- ✓ F136 PDR
- ✓ CSAF Risk Brief
- ✓ Congressional Staffer Briefs
- ✓ CINCLANT Brief
- ✓ 3 x SAE Program Review
- ✓ 2 x Configuration Steering Board
- ✓ 1 x Senior Warfighters' Group
- ✓ 1 x Program Management Review
- ✓ GPA Submitted to Congress
- ✓ FACO Report
- ✓ Small Business Plans
- ✓ Collier Trophy
- ✓ Denmark MOU Signing
- ✓ Dutch MOU Signing
- ✓ Italian MOU Signing
- ✓ Norwegian MOU Signing
- ✓ Turkish MOU Signing
- ✓ Australian MOU Signing
- ✓ AT&L ADM Action Item Briefing
- ✓ Lines Freeze
- ✓ 2 x International EC
- ✓ 2 x CEO Conference
- ✓ 1 x Program Management Review

***Life is Good and Busy***



# LOCKHEED MARTIN PROGRAM RISKS

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- Software Executability
- Lift System Hardware
- Trained Manpower Availability
- Supplier/Partner Management
- Mission Systems Fusion Algorithms
- Deck Crew Environment
- Interoperability
- Anti-Tamper
- Multi-Level of Classification
- Production URF
- Process & Tool Performance
- Air Vehicle Weight Control
- Electro-Hydraulic Actuator Development
- Canopy Bird Strike Compatibility
- Requirements Control Under Performance Based Specification
- STOVL Vmil
- TAA Process Maturity

***All program level risks are reviewed with JPO/Lockheed Martin concurrence  
Mitigation plans are in place to status risk reduction progress***





# NEAR TERM MILESTONES

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- **System Requirements Reviews (SRR)**
  - P&W complete December 2001 ☒
  - LM complete February 2002 ☒
  
- **Integrated Baseline Reviews (IBR)**
  - GE/RR March 2002 ☒
  - P&W March 2002 ☒
  - LM April 2002 ☒
  
- **Preliminary Design Review (PDR)**
  - P&W May 2002 ☒
  - GE/RR July 2002 ☒
  - LM March 2003 ☐



# INTERNATIONAL COOPERATIVE AGREEMENTS

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**Level I – UK Memorandum of Understanding  
(MOU) Signed 17 Jan 2001**



**Level II – Italy MOU Signed 24 Jun 2002**



**Netherlands MOU Signed 10 Jun 2002**



**Level III – Turkey MOU Signed 11 Jul 2002**



**Canada MOU Signed 7 Feb 2002**



**Australia MOU Signed 31 Oct 2002**



**Denmark MOU Signed 28 May 2002**



**Norway MOU Signed 20 Jun 2002**

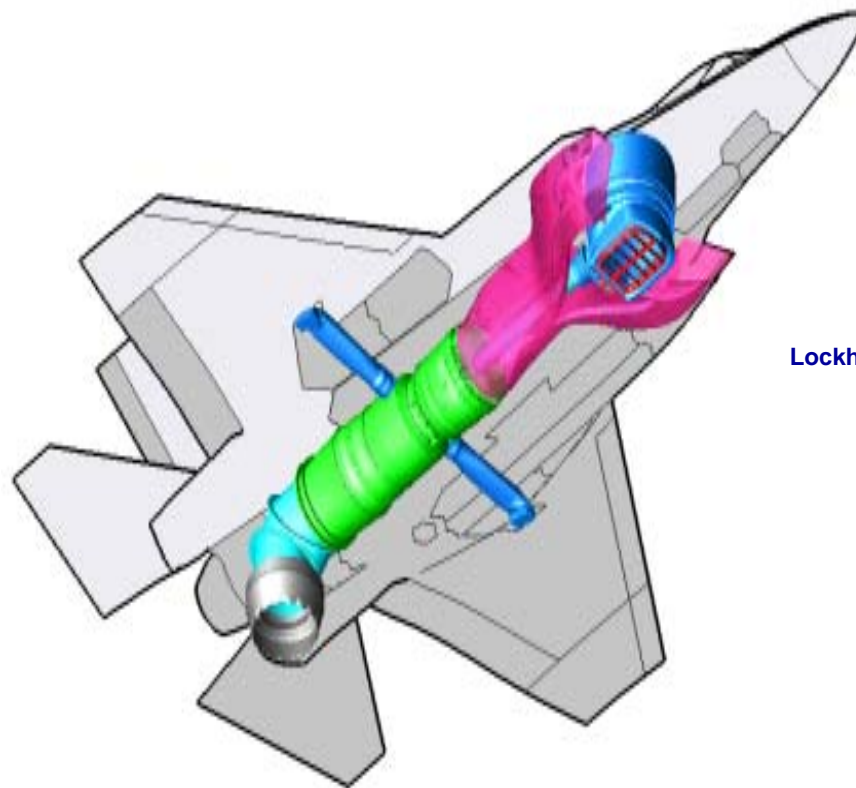




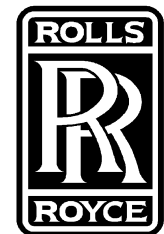
# THE JSF INTEGRATED LIFT FAN PROPULSION SYSTEM



*Winner of  
The 2001 Collier Trophy*



Lockheed Martin Aeronautics Company





# JSF PROGRAM SUMMARY

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- **Teamwork...has been and will be the key to success**
- **International Participation in All Facets**
- **Capitalizing on Advances in Powered Lift Technology**
- **Every Wicket, Every Day!**



***JSF - Lethal, Survivable, Supportable, Affordable***



DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.



## WORKING TO AFFORDABLY MEET THE REQUIREMENTS OF THE WARFIGHTER

